DEVELOPMENT OF NATIONAL SPATIAL DATA INFRASTRUCTURE IN KOREA

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ABSTRACT

The Korean government has initiated a full-scale implementation of the Master Plan of National Geographic Information System(NGIS) in 1995. The success of the 1st Master Plan of NGIS marrks a turning point in the physical management system of our land. The Master Plan of NGIS includes generation of spatial databases for NGIS, establishment of data standardization, assistance of GIS-related technical development and development of framework for utilization and application of NGIS

The NGI(National Geography Institute) plays a crucial role in surveying and mapping activities, and responsible for the Geographic Information Subcommittee of the Steering Committee in the Master Plan of NGIS. In order to come along with National project, the NGI has already expanded its organization and members. The progress has rapidly been achieved in the generation of national digital base maps, underground utility maps and thematic maps.

The first phase of the Master Plan of NGIS will be completed by the year of 2000. The main purpose of the first phase is to establish basic GIS infrastructure such as to produce various kind of digital maps. The second phase of the NGIS which is start from 2001 through 2005 is to the spread of GIS application, maintain the digital maps. During the second phase of NGIS the NGI has planed to updating the digital maps and provide framework data. And also to contribute the implementation of the regional and global Spatial Data Infrastructure as Asia-Pacific Spatial Data Infrastructure(APSDI) and GSDI, the NGI will be closely cooperate with the member countries of PCGIAP and GSDI.

1. INTRODUCTION

1.1 Background of NGIS

No sector of the world today is untouched by the wave of information technology. Land information is no exception and has rapidly been informationized owing to the development of computers and ever-increasing demands for land information. The main purpose of informationizing land information is the efficient use and management of land. Land is not only the object of economic development but also the object of preservation for a pleasant environment.

In this information era, Korea is devoting much time and energy to establish an information system in the land-related sector. To create the land-related information system, what is needed is a comprehensive and efficient means of management. Geographic Information System (GIS) which meets the needs of this information era, is considered as an ingenious device that makes the efficient management of land possible. Korea became increasingly aware of the importance of the GIS for various fields such as urban management, disaster prevention and infrastructure management and environment protection, etc. In addition, the GIS is being more and more frequently used in administrative affairs including distribution of land information and public welfare services. Under this trend, this GIS will undoubtedly become a valuable social overhead capital in the 21st century.

Even though the GIS is still unfledged in Korea, it is well recognized that we must develop a National Geographic Information Infrastructure and foundation for the effective distribution and application of Geographic Information. The master plan for National Geographic Information System (NGIS) of Korea which was initiated and designed by Central Government, will play a decisive role in our National GIS Development Program.

On May 1995, the Korean government has implemented “A Master Plan of National Geographic Information System(NGIS)” in order to develop the information infrastructure for geo-spatial data management. Since then, the GIS data compilation work in various sectors is successfully making headway. There is a wide recognition of the necessity for the legal supporting system to ensure the implementation of NGIS. Therefore the NGIS law and regulation enacted in January 2000 has take effect from July 2000.

1.2 Objectives of NGIS

The Korean government has initiated a full-scale implement of the NGIS Master Plan in 1995. The GIS data compilation work in various sectors is successfully making headway.

The national digital basemaps has been rapidly progressed. Plans for digital underground utility and thematic maps are also underway. Furthermore, the local autonomous groups are promoting the use of GIS in various fields including the management system for urban areas and facilities.

The goal of the NGIS master plan is to develop environmentally healthy and pleasant land as well as to promote national competitiveness and productivity. It is expected the success of the NGIS Master Plan to mark a turning point in the management system of our land.

The major issues of the NGIS Master Plan can be categorized as follows:
– Establishment of spatial databases for the NGIS
– Establishment of data standardization
– Assistance of GIS-related technical development
– Development of framework for utilization and application of the NGIS

2. DEVELOPMENT STRATEGIES FOR THE NGIS

Currently, the Korean government plays a major role in the NGIS, especially in the area of the development of spatial database and the standardization of spatial data. Technology development and training of GIS specialists are also considered as one of the major of government.

The overall objectives of the NGIS are i) to establish a geographic information infrastructure in Korea, and ii) to eliminate unnecessary duplicate investment for GIS. To achieve the objectives of NGIS, the NGIS Steering Committee developed the following phase-by-phase strategies:

Phase 1 (1995~2000): GIS Infrastructure foundation period
- Establishment of basic database for spatial information
    - Database design
    - Digital mapping of the topographical data
- Development of GIS -related technology and training of GIS specialists
    - Development of GIS fundamental technology
    - Development of GIS application
    - Training of GIS specialists
- Standardization of spatial data
    - Standard for basic spatial data
    - Spatial data transfer format
- Financial support for development of GIS application systems
    - Spatial Decision Support System
    - Administration support system

- Management and distribution of spatial information
    - Implementation and operation of information database clearing house
- Development of spatial data-related legislative law and framework
- Joint funding between public and private sector
- Update and modification of the NGIS Master Plan - rolling annual plans

Phase 2 (2001~2005): GIS data utilization period;

- develop national framework data base
- create mechanism to ensure adequate management, distribution and security of data
- develop mechanism for update of data
- provide mechanism to permit the total integration of government data based upon technologies now emerging and national and international standards as relevant
- provide an environment in which commercial support for NGIS can be agreed and implemented
- training of GIS experts
- promote partnership between public and private sector

Phase 3 (2006~): GIS exploitation period by completing arranging the national spatial data infrastructure and diffusing GIS generally;

3. THE STRUCTURE OF THE NGIS COMMITTEE

To proceed and implement the first five-year master plan, among 11 Ministries in Korea, Ministry of Construction and Transportation(MOCT) plays a leading role in the NGIS master plan. The vice minister of MOCT is chairing the NGIS steering committee. Under the steering committee, there are 5 subcommittees and an advisory board. These subcommittees for NGIS development have already been in operation and the central government is currently involved in each subcommittee. The followings is the brief description of each subcommittee during the 1st NGIS Master Plan period(1995~2000):

a) Administrative Subcommittee mainly performs the overall administrative work such as management and support of subcommittees. It is also responsible for financial matters in NGIS master plan.
b) Geographic Information Subcommittee is mainly in charge of generating digital base maps, thematic maps and underground facility maps
c) GIS Technology Subcommittee takes technical part of the NGIS master plan. It is responsible for developing GIS technology as well as training of GIS specialists.
d) GIS Standard Subcommittee focuses on determining national standards such as spatial data transfer format, digital base map feature codes and so on.
e) Cadastral Information Subcommittee prepares a framework of cadastral information system within NGIS

The NGIS committee structure during the period of the first master plan has the coordination problem because 12 different ministries were involved in the GIS development. And the structure of NGIS committee was inappropriate to take up the newly emerging issues such as the establishment of clearinghouse and distribution network, GIS industry promotion, human resource development, etc.

In this regard, the NGIS committee structure was reformed in 2000 and the level of NGIS Steering Committee has been up-positioned to the Minister of Construction and Transportation. Under the NGIS steering committee, there were established following 7 sub-committees in the 2nd NGIS Master Plan period(2001~2005):

a) Coordinating and Planning Subcommittee: Coordinating and adjusting roles, Enactment and revision of Law
b) Geographic Information Subcommittee: development of framework data and thematic data
c) Technology Development Subcommittee: Design of overall technical architecture, Study and research on GIS software
d) Human Resource Development Subcommittee: Education and training of human resources
e) Cadastral Information Subcommittee: Cadastral map digitization, utilization of Cadastral maps
f) Industry promotion subcommittee: development of strategies to support GIS industry
g) Data distribution and utilization subcommittee: establishment of the clearinghouse and distribution network. Promotion of utilization of GIS

4. THE SECOND MASTER PLAN OF THE NGIS

To accomplish the master plan effectively and efficiently, the NGIS steering committee selected several major tasks and projects; a) national framework database, b) development of integrated underground facilities management system, c) development of thematic maps and public utilization system, d) establishment of national clearinghouse, e) standardization of geographic information, f) GIS human resource development
The figure 1 and 2 are a promotion strategy and plan of the second master plan, respectively

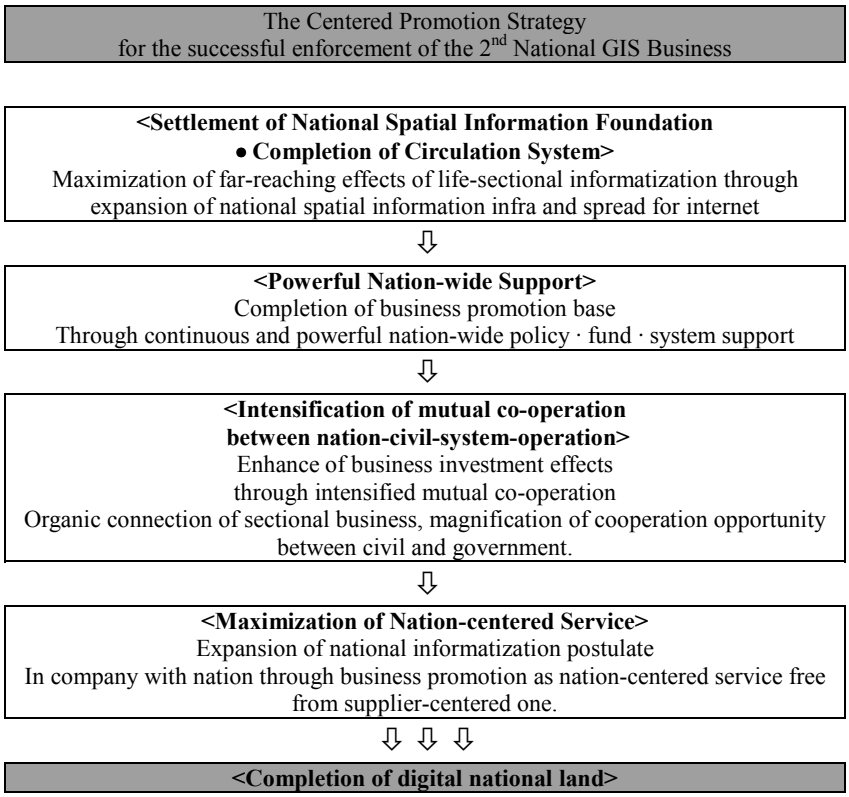

Figure 1. Promotion Strategy

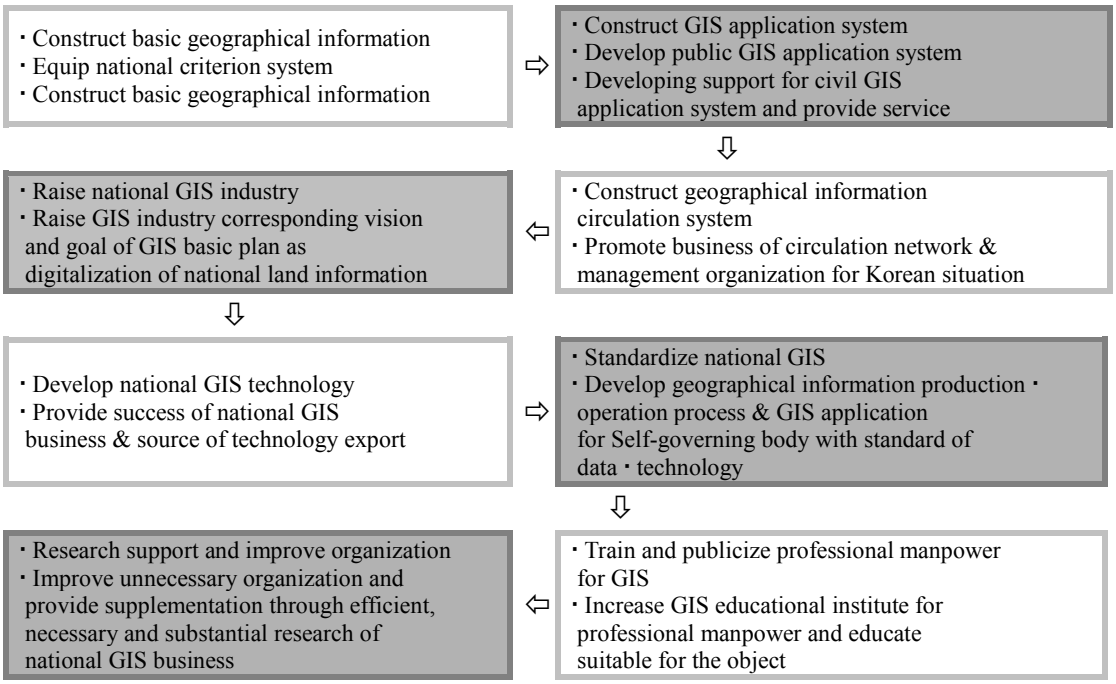

Figure 2. Classified Promotion Plan

4.1 Establishment of National Framework Data base

Framework data is the fundamental data set as a basic and reference map to which specific information can be added for the respective purpose of diverse GIS application areas. As a first step of establishing national framework data base, National Geography Institute (NGI) with local governments focused on the digitalizing of the national base maps, which is scales 1:1,000, 1:5,000, 1:25,000, since 1995. The digitalization of base map completed by the end of 2000.

- **1:1,000 Scale Digital Map**

The 79 major cities had digitized by the year of 1999 with total number of map sheets of 12,428. The central and local government are responsible for the even investment. Since 1995, the 1:1,000 digital map was made by the NGI. For the 1:1,000 scale maps, the photogrammetric technique is mainly implemented for the digital mapping. However some of these maps had digitized through scanning the existing maps.

- **1:5,000 Scale Digital Map**

The 1:5,000 scale map is the topographic base map, which is planned to cover the whole country. The covering areas are about 70,000 and total number of map sheets is 16,200. the NGI are responsible for the generation of 1:5,000 digital mapping. the NGI has a full responsibility of the maintenance and updating the whole 1:5,000 digital map. The central government and 7 government-affiliated companies are investing the generation of 1:5,000 digital maps. The 1:5,000 maps are digitized through the combination of scanning the existing maps and the photogrammetric techniques. The total 16,194 sheets of 1:5,000 Scale Digital Map were produced in 2000.

- **1:25,000 Scale Digital Maps**

The 1:25,000 scale maps will be digitized, especially for the mountainous areas. But the NGI had changed the plan to cover the whole country. Since 1991, there were 750 map sheets generated. The total number of map sheets will be 768.

- **Framework Data**

In the second master plan, it has introduced a new concept for the NGIS base map that is a framework data. It is required urgently to build the national framework data. The national framework data is the skeleton of diverse spatial information capable of overlapping and adding spatial data, both schematically and spatially upon need basis. Therefore the phase 2 NGIS master plan(2001~2005) will focus on the establishment of framework data base as follows;

a) Administrative boundary: national, provincial administrative boundaries
b) Transportation: road, railway, airport, seaport, shipping facilities etc.
c) Hydrology: marine and water resource, stream, basin, watershed, lake, etc.
d) Cadastral information: Cadastral maps, land registration

e) Geodetic reference frame: surveying control point, Geoid model,
f) Topography: DEM, contour, and height data
g) Facilities: including national, municipal and provincial designated cultural properties
h) Satellite images and aerial photographs

In making a selection of framework data in theme, the following elements shall be considered;

a) geographic information based within the fundamental framework of NGIS
b) Basic geographic information that is both widespread and can be used manifold;
c) Geographic information that can be merged both figuratively or spatially, or piled up

In 2001~2002, the pilot project will be carried under direction of NGI which held Geographic information subcommittee. The aim of these pilot project is to develop strategies, guidelines, standardization for framework data. From 2003, the main project will be started to use the results of pilot project.

4.2 Underground Facilities Management System

The gas explosion accidents in Seoul and Taegu in 1994 and 1995 respectively has accelerated the development of underground facilities management system. The Korean government started to develop integrated underground facilities management systems in 7 areas as sewerage, water, communication, gas pipelines, electricity lines, heating and oil pipeline. To work out efficiently and effectively, Kwachon pilot project has started in August, 1996 and finished on April 1997, sponsored by the Ministry of Construction and Transportation as one of NGIS major project.

Achievements in the pilot project in Kwachon are as follows;

a) Sort of problems like legal, financial technical , organization, etc. which would be exposed in course of developing facilities management system has been found.
b) The content of works and linkages between central government , local government and related state-run organization has been analyzed.
c) Guidelines for developing integrated underground facilities management systems applied overall to development and management of related systems on a national level has been developed.

With the experience and results from Kwachon pilot project, the NGIS Steering Committee decide to have 19cities develop integrated underground facilities management system until the end of 2002 and further extend to all the cities cross the country.

4. 3. Utilization and Clearinghouse for national spatial data distribution

The first NGIS master plan mainly focused on building the foundation and circumstances of GIS infrastructures. As part of GIS infrastructure foundation, the different categories of digital maps had been developed: topographic maps, thematic maps – road network map, land use map, urban planning map, etc. However, one of the serious problems encounters during the first master plan period was that there was no spatial data distribution network and clearinghouse. Therefore, the second master plan aims to maximize of utilization the already established spatial information by establishing clearinghouse and distribution network for national spatial data. In this regard, the NGIS Steering Committee plans to establish the clearinghouse and distribution network.

4.4 Standardization of Geographic Information

The first stage implementation of the NGIS Master Plan was completed during the period from 1995 to 2000. Under the umbrella of the steering committee, there were 5 subcommittees (administrative, geographic information, GIS technology, GIS standards and cadastral information) and an advisory board. The GIS standards subcommittee was responsible for defining geographic information standards. During the course of this work, the geographic information standards established by GIS standards subcommittee took account of ISO standards, keeping pace with the international community

In the first stage of the NGIS master plan, the standards for geographic information were driven in two different areas:

- geographic information production;
- geographic information distribution/application.

- Geographic information production

The National Geography Institute (NGI) played a key role in defining the standards in geographic information production. A total of ten of standards were established in this area (including national base map, underground utility map and thematic map).

- Geographic information distribution/application

Two standards were established in this area (including a temporary metadata standard and a data exchange standard (SDTS)). These standards aimed at exchanging and searching the geographic data produced by many different organizations and agencies.

For the second stage of the NGIS plan starting in 2001, the strategy and plan on national standards are being arranged to cope with recent technology development, as well as to meet the wide range of customers' requirements.

4.5 Technology Development

For the development of GIS technologies, approximately US$22.75 million was allocated during the first 5 year master plan. Technology development has been in made for area; i) GIS system integration technology, ii) Mapping, iii) DB tool; iv) GIS application software.

4.6 Human Resource Development

Human resource development issues are also indispensable element to realize the objectives and goals of NGIS. The NGIS committee is going to increase professional manpower who are involved in NGIS activities, both in government and business.
GIS professional manpower training for has been done mainly in university, government run training institute and business institute. As a part of increasing professional manpower training, the NGIS committee is also considering to develop virtual GIS training center which provides cyber-training course through internet.

4.7 Computation of Investment Scale

Share the investment source for the public and civil partnership and induce investment to the civil section. Procurement plan for financial resources such as total investment scale, sectional investment scale and share with civil section will be promoted after consultation with connected section such as the Ministry of Planning and Budget.

Table 1. Estimated Investment (Unit : Million WON)

Section	Required Sum
- Construct, maintain and manage basic geographical information	450,400
- Construct, maintain and manage GIS application system	733,600
- Construct geographical Information circulation system	25,000
- Develop national GIS technology	80,500
- Raise GIS industry	25,000
- Standardize national GIS	9,000
- Raise and publicize professional manpower for GIS	14,800
- Support research & organization development	11,700
TOTAL	1,350,000

4.8 Promotion Organization per Theme

Promotion Subject	Supervising Organization (Cooperating organization)	Remark
Establishment of Framework data base		
Establish the national reference coordinate system	Geographical information part (MOGAHA, MOMAF, MND)	From 2001
Pilot project for establishment of framework data base	Geographical information part (MOCT, MOGAHA, MOMAF)	2001-2002
Establishment national framework database	Geographical information part (MOCT, MOGAHA, MOMAF)	From 2003
Construct application system		
Connected information with land utilization and public limitation	MOCT, Self-governing body MAF, ME, RDA, FOA)	2001-2003
Geographical information for 7 underground facility	Geographical information part (MOCT, MOCIE, ME, Self-governing body, Investment organization)	2001-2005
Underground geographical information	MOCT, MOCIE, MCT, Investment organization	2001-2005
Geographical information of environment, agriculture and forestry	MAF, ME, RDA, FOA (MOCT)	2001-2005
Geographical information of maritime affairs and fisheries	MOMAF (ME, MOCT)	2001-2005
Support for public and civil application system	Organization, Enterprise, Committee, Civil community	Continue
Construct circulation system of geographic information		
Research of circulation managing organization establish plan and organize practical affair committee	Application & circulation section	By 2001
Construct circulation network, establish and maintain managing organization	Application & circulation Section (Self-governing body Investment organization)	From 2001
Develop national GIS technology		
Annual development of centered basic technology	Technical part (Research institution, College, Enterprise)	From 2002
Establish GIS technology center, Organize and manage GIS professional group	Technical part (Research institution, College, Committee)	From 2001
Construct national technology information network	Technical part (Research institution, College, Committee)	From 2002
Promote GIS industry		
Promote GIS industry and complete overall countermeasure for recourse	Industry raising part (Research institution, Committee, Community)	From 2001
Excavate and raise small and medium enterprise for professional GIS	Industry raising part (MOFAT, Committee)	From 2001
Support export of national GIS basic technology	Industry raising part (MOFAT, Committee)	From 2001
Support development of process & application For national basic information	Industry raising part (Organization, Committee, Enterprise)	From 2001

Standardization of GIS		
Complete national GIS standard system	NGI, MIC, MOCIE	By 2002
Promote principal industry for sectional standardization	Organization, College, Research institution, Community	From 2001
Promote research industry of national GIS standardization continuously	Organization, College, Research institution, Community	From 2001
Strengthen international GIS cooperation For global standard development	Organization, Academy, Connected committee, Community	From 2001
Develop & support common application standard model Per self-governing type	Total control part (Organization, Self-governing body, Research institution)	2001-2005
Raise and publicize professional manpower for GIS		
Increase GIS manpower training institute	Manpower raising part (Organization, Self-governing body, Investment institution, Committee, Community)	From 2001
Support development of education program	Manpower raising part (MIC, MOCIE, MOE, College, Research Institution)	From 2001
Expand educational opportunity for GIS charger of public organization	Manpower raising part (Organization, Self-governing body, Investment institution)	From 2001
Intensify school education	Manpower raising part (MOE, MIC, MOCIE)	From 2001
Establish & manage GIS educational publication center	Manpower raising part (MOE, MIC, MOCIE, College, Enterprise, Committee)	From 2002
Hold GIS Expo	(Related Organizations)	From 2001
Support research and system development		
Perform national GIS support research	Total control part (Organization, Self-governing body, Research institution, Enterprise)	From 2001
Introduce GIS supervision system	MOCT, MIC (Organization)	From 2001
Develop measuring system	MOCT, MOGAHA, MOMAF,	From 2001
Complete law & system for activation of satellite reflection	MOCT, MOST, MIC	From 2001

4.9 Effect valuation for national GIS investment

This is for maximization of investment efficiency according to completing development plan for the problem through systematic valuation, which is put to practical use of annual expense/effect-analyzing method per sectional investment effect through national GIS business promotion. Applying the valuation result, we derive the problem on plan and business promotion, and take up the reflected and settled plan from the fundamental one.

5. CONCLUSION

The first phase of the National Geographic Information System(NGIS) Master Plan will be completed by the year of 2000. The main purpose of the first phase is to establish basic GIS infrastructure such as to produce various kind of digital maps. The second phase of the NGIS which is start from 2001 through 2005 is to the spread of GIS application, maintain the digital maps.

The main focus of 2nd NGIS master plan are:

a) establishment of national framework data base
b) set-up of clearinghouse and distribution network of GIS data
c) Research and development of technologies
d) Human resources development

These enormous tasks will be proceed in close cooperation between government, academia and private sector as well as international cooperation. During the second phase of NGIS the NGI has planed to updating the digital maps and provide framework data. And also to contribute the implementation of the regional and global Spatial Data Infrastructure as Asia-Pacific Spatial Data Infrastructure(APSDI) and GSDI, the NGI will be closely cooperate with the member countries of PCGIAP and GSDI.

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